

Answers

Last new thing for this unit: Using Empirical formula to find actual Molecular formula



Name _____
Period _____

the test is Thursday

1. Given info: A colorless, poisonous, sweet-tasting clear liquid has 18.015g C, 4.545g H, and 24.00 g O. Its molecular weight is 62 g/mole.

Find the empirical formula

$$18.015g C \times \left(\frac{1 \text{ mol C}}{12.01 \text{ g C}} \right) = 1.5 \text{ mol C}$$

$$4.545g H \times \left(\frac{1 \text{ mol H}}{1.01 \text{ g H}} \right) = 4.5 \text{ mol H}$$

$$24.00g O \times \left(\frac{1 \text{ mol O}}{16 \text{ g O}} \right) = 1.5 \text{ mol O}$$

ANSWER $C_1H_3O_1$

Find what the mass would be for a mole of this empirical formula. $C_1H_3O_1$

$$1 \times 12.01 \text{ g/mole} = 12.01$$

$$3 \times 1.01 \text{ g/mole} = 3.03$$

$$1 \times 16.00 \text{ g/mole} = 16.00$$

$$31.04 \text{ g/mole}$$

Now randomly choose a few integers and multiply your empirical mass by them.

31.04
62.08 ← the molecular formula is $C_2H_6O_2$
93.12

Write the molecular formula here _____

substance A	C_2H_4	$C_{10}H_{40}$	2. The first column shows (molecular / empirical) formulas.
substance B	C_2H_2	$C_{10}H_{10}$	3. The second column shows (molecular / empirical) formulas.
substance C	C_3H_4O	C_3H_4O	

4. What is the % by mass of oxygen in $Mg(NO_3)_2$?
(2)

→ find total mass
→ find oxygen mass

$$\frac{96 \text{ g oxygen}}{148.33 \text{ g total}} \times 100 = 65\%$$

(3)

5. Given info: You buy a used car and in the trunk find a Tupperware tub with a substance. When analyzed it has 6.93g of oxygen and 0.43 g of hydrogen. If the molar mass of the compound is 34.0 g/mole, what is the molecular formula?

Find the empirical formula

$$6.93 \text{ grams O} \times \left(\frac{1 \text{ moles O}}{16.00 \text{ g O}} \right) = 0.433 \text{ moles O}$$

$$0.43 \text{ g H} \times \left(\frac{1 \text{ mol H}}{1.01 \text{ g H}} \right) = 0.426 \text{ moles H}$$

answer: O_1H_1

Find what the mass would be for a mole of this empirical formula.

Oxygen: $1 \times 16.00 = 16.00$
 Hydrogen: $1 \times 1.01 = 1.01$
 $\hline 17.01 \text{ g/mole}$

Now randomly choose a few integers and multiply your empirical mass by them.

$\times 1 = 17.01$
 \rightarrow times two = 34.02
 \rightarrow times three = 51.03

Write the molecular formula here O_2H_2

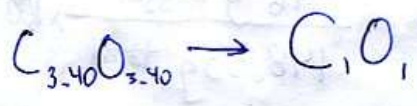
(4)

6. What is the empirical formula of a carbon-oxygen compound, given that a 95.2 g sample of the compound contains 40.8 g of carbon and the rest oxygen?


$$40.8 \text{ g C} \times \left(\frac{1 \text{ moles C}}{12.01 \text{ g C}} \right) = 3.40 \text{ g C}$$

If the total and the carbon are subtracted, it gives the oxygen mass of the sample: $95.2 - 40.8 = 54.4 \text{ grams}$

$$54.4 \text{ grams O} \times \left(\frac{1 \text{ mol O}}{16.00 \text{ g O}} \right) = 3.40 \text{ moles O}$$



7. A sample of iron oxide was found to contain 1.116 g of iron and 0.480 g of oxygen. Its molar mass is roughly 5 x as great as that of oxygen gas. Find the empirical formula and the molecular formula of this compound.

Careful! Oxygen gas looks like this!  and is 32.0 grams/mole

$5 \times 32 = 160 \text{ g/mol}$ this is the molar mass

$$1.116 \text{ g Fe} \times \left(\frac{1 \text{ mole}}{55.85 \text{ g Fe}} \right) = 0.0200$$








$$0.480 \text{ g O} \times \left(\frac{1 \text{ mole}}{16.00 \text{ g O}} \right) = 0.0300$$

$$\begin{array}{r} 2 \times 55.85 = 111.7 \\ 3 \times 16.00 = 48.0 \\ \hline 159.7 \text{ g/mole} \end{array}$$

Answer
Molec Formula is
 Fe_2O_3

Key to understanding the cartoons on this sheet:

1 chlorine atom	1 hydrogen atom	1 oxygen atom	1 nitrogen atom	1 carbon atom
				



8. Calculate the molecular mass of the molecule shown at the left.

Formula: $\text{C}_3\text{O}_3\text{H}_8$

$$\begin{array}{r} 3 \times 12.01 = 36.03 \\ 3 \times 16.00 = 48.00 \\ 8 \times 1.01 = 8.08 \\ \hline 92.11 \text{ g/mol} \end{array}$$

9. What is the molecular mass of $\text{Fe}_2(\text{CO}_3)_3$.

$$\begin{array}{r} 2 \times \text{Fe} = 2 \times 55.85 = 111.7 \\ 3 \times \text{C} = 3 \times 12.01 = 36.03 \\ 9 \times \text{O} = 9 \times 16.00 = 144.00 \\ \hline 291.73 \text{ grams/mole} \end{array}$$

4	4(2)	8
5	5(3)	15
5	5(3)	15
5	6(4)	24
0	7(5)	35
6	7(5)	35
7	8(6)	48
7	9(7)	63